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ABSTRACT

This project was designed to develop a test of modality (eye/ear) endowment and to determine the significance of this factor in foreign language instruction. Subjects were junior and senior high school students enrolled in French and Spanish classes. In phases 1 and 2 the Modality Endowment Battery of tests (MEB) was constructed and shown to have high reliability. Phase 3 was designed to determine its concurrent and predictive validity. Results were interpreted as generally supportive in the concurrent validity study. The predictive validity study was intended to determine whether auditory students (as measured by the MEB) learn better in classes where the teacher uses auditory methods, and visual students in classes where visual methods are used. Since no teachers were found who used highly visual methods, no such comparison was made. In the 13 classes tested, in all of which highly auditory or mixed audiovisual methods were used, no significant connection was found between students' modality endowment and their foreign language achievement. Phase 4 tested modality endowment in relation to various indicators of the attitude and achievement of foreign language learners. Several hypotheses were tested, and little relationship was found to exist. The conclusion made was that, despite many students' belief that they learn better through one modality or the other, this factor is not a significant influence in foreign language learning. (Author/PM)

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Final Report

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Project No. 20-6052A
Contract No. OEC-0-713633(823)

Paul Pimsleur, Stephen Burger, and Martin Fogelman
Research Foundation of the State University of New York
P. O. Box 7126
Albany, New York 12224

MODALITY ENDOWMENT IN FOREIGN LANGUAGE LEARNING

June 30, 1974

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U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

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ABSTRACT

This project aimed to develop a test of modality (eye/ear) endowment and to determine the significance of this factor in foreign language instruction. In Phases 1 and 2 the Modality Endowment Battery (MEB) was constructed and shown to have high reliability.

Phase 3 was designed to determine its concurrent and predictive validity. In the concurrent validity study, for which 140 first-year French and Spanish students in junior and senior high schools served as subjects, MEB scores were correlated with scores on several FL aptitude and achievement measures. The results were interpreted as generally supportive of the MEB's validity.

The predictive validity study (N=320) intended to determine whether auditory students (as measured by the MEB) learn better in classes where the teacher uses auditory methods, and visual students in classes where visual methods are used. This intention could not be carried out, as no teachers were found who used highly visual methods. In the 13 classes tested, in all of which highly auditory or mixed audio-visual methods were used, no significant connection was found between students' modality endowment and their FL achievement.

Phase 4 aimed to test modality endowment in relation to various indicators of the attitude and achievement of foreign language learners (N=50). Several hypotheses were tested and little relationship was found to exist. The conclusion was drawn that, despite many students' belief that they learn better through one modality or the other, this factor is not a significant influence in foreign language learning.

Final Report

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MODALITY ENDOWMENT IN FOREIGN LANGUAGE LEARNING

Paul Pimsleur, Stephen Burger, and Martin Fogelman
State University of New York at Albany
1400 Washington Avenue
Albany, New York 12222

June 30, 1974

The research reported herein was performed pursuant to a contract with the Office of Education, U.S. Department of Health, Education, and Welfare. Contractors undertaking such projects under government sponsorship are encouraged to express freely their professional judgement in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official Office of Education position or policy.

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Institute of International Studies, Division of Foreign Studies

PREFACE

The investigators would like to express their appreciation to the schools, principals, and teachers involved in the project. The cooperation received was outstanding and necessary for the completion of the study. Particular thanks are extended to Mr. Arthur Cotugno and Mr. Umberto De Rose of the Amsterdam School District in Amsterdam, N.Y. and Mr. Tom O'Brien of the North Colonie Central School System in Latham, N.Y. and to Mr. Ed Wuinee and Dr. Fred W. Burdick of the Bethlehem Central School District in Delmar, N.Y. It is also in order to thank Mr. Robert Pfeiffer and SUNY Academic Services for the special handling given data needing to be computer-processed.

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PART I - INTRODUCTION

The purpose of this study is to investigate the possibility of the existence of auditory and visual learning differences among a selected population, foreign language learners. The compelling reasons for this pertain to the use of the audio-lingual method as the prevailing method of instruction and the high incidence of learning difficulty (dropout, low grades, underachievement). It was felt that some kind of interaction between mode of instruction (audio-lingual method) and modality endowment might be at the root of the failure of many students to learn a foreign language successfully, and that it would be advantageous to develop an instrument to identify modality differences, so that methods and materials could be geared to the students' preferred modes of processing information.

In Phase 1 of this investigation (see Appendix A), a battery of tests for identifying learning efficiency in the auditory and visual sense modalities was constructed and refined. The result was the Modality Endowment Battery (MEB) shown in Appendix C. Phase Two (see Appendix B) was devoted to assessing the reliability of the MEB, which was found to be highly reliable. The purpose of Phases 3 and 4, with which this report is chiefly concerned, was to determine the concurrent and predictive validity of the MEB, and to explore several hypotheses concerning the relationship between modality endowment and foreign language learning.

The supposition that there are differences in the manner and mode with which a learner processes information is a well-documented empirical finding as evidenced in part by the works of Day and Beach (1950), which is a comprehensive review of modality literature up to that point, Budoff and Quinlan (1964), Asher (1964), Van Mondfrans and Travers (1964), Horiuchi (1966), Murdock (1966), Brown and Hopkins (1967), Corballis (1967), Milgram (1967), Beery (1968), Bahrick and Boucher (1968), Murray and Roberts (1968), Baker and Peyne (1968),

Murdock and Walker (1969), Craik (1969), Levin, Rohwer, and Cleary (1971), and Williams, Williams, and Bloomberg (1973). These authors each identified some aspect of differential ability to process information according to sense modality. The problem has been that the nature and direction of these differences has been confounded as much as clarified by the empirical data thus far produced.

PART II - METHODS

Experimental Design

The experimental design for Phase 3 of the study was broken into two distinct parts which explored the concurrent and predictive validity of the MEB, respectively.

Experiment One was a concurrent validity study in which the modality variable would be examined in relation to other known variables in foreign language achievement. Scores on the Language Aptitude Battery, IQ scores, English grades, math grades, scores on the Listening and Reading parts of the Pimsleur Proficiency Tests and final grades in language were collected for each subject. Multiple correlation techniques were used to examine the relationships among these variables.

Experiment Two was designed to assess the predictive validity of the MEB by comparing the modality endowment of the students with the teaching method (auditory, visual, or both) favored by their teachers.* The hypothesis was that students strong in auditory endowment would do better in an auditory learning environment. The learning environment created by each teacher was measured by the Modality Environment Instrument (MEI).

Experiment Two was originally designed to yield a 3 x 3 matrix in which students achievement scores in language would be analyzed in relation to their modality endowment (auditory, no preference, visual) and the modality environment in their classroom (auditory, auditory-visual, visual). However, after the study began it became clear that the 13 teachers involved did not differ to any considerable extent in the modality environment they created. All teachers used auditory methods, to one degree or another. The modality environment variable was therefore compressed from 3 distinct types to one mixed type (between A and A-V), which was an impoverishment of the original design.

Phase 4, designed as a follow-up after Experiment 2 failed to

*By a "visual" environment we mean a heavy dependence on reading and writing. We do not mean extensive use of pictures, as favored by many "auditory" teachers.

yield the expected data, aimed to test modality endowment in relation to various learner characteristics--expressed modality preference, foreign language attrition, teachers' evaluations of students' attentiveness in class and of their performance in the various language skills, students' opinions of particular activities within the class, and students' liking for foreign languages as compared with other subjects.

Experimental Populations

Subjects for the concurrent validity study were 140 students in first year French and Spanish classes in Theodore Roosevelt Junior High School, Amsterdam, N.Y. They represent a cross section of IQ and socio-economic levels.

Subjects for the predictive validity were 320 first year French and Spanish students in four schools in Northeastern New York. They, too, represent a cross section of socio-economic and IQ levels. The four schools were: Wilbur Lynch High School, Theodore Roosevelt Junior High School, Shaker Junior High School, and Bethlehem Middle School.

Subjects for Phase 4 were 50 students from Wilbur Lynch High School and Shaker Junior High School who, while in first year foreign language classes, had received an MEB score that identified them as distinctly auditory or visual (25 of each).

Modality Endowment Battery (MEB)

The MEB consisted of two tests, a Paired Associate test and a Persian Vocabulary test. These tests were administered in two conditions to counterbalance the design: an A-V condition in which auditory responses were required for all odd numbered sets and visual responses for even numbered sets, and a V-A condition in which the procedure was reversed. The stimulus items in each set remained the same without regard to A-V or V-A condition.

The two tests were administered as a coordinated audio-visual program. The equipment used was a Wollensak 2550 tape recorder and a Kodak (ektographic) Carousel Slide Projector with Zoom Lens. The auditory stimuli and all instructions were presented by the tape recorder. Two experimenters were present to answer S's questions at specific pauses in the instructions on the tape. The visual stimuli were triggered by an impulse generated from the tape recorder. The time for both presentations was controlled so that the auditory and visual stimuli were presented for the same period of time. The answer sheets were in booklet form; instructions on the tape recorder told S's when to turn pages and where to mark answers. Time for administration of both tests was approximately 50-60 minutes.

Test One was the Paired Associates Test consisting of 96 pairs of items presented in 16 sets of 6. The 16 sets were administered in alternate visual and auditory order. In the V-A condition, the first 6 pairs (Set 1) were presented visually, 2 seconds per pair, after which the S's were instructed to turn to the appropriate answer sheet and mark their answers to set 1. They were to identify the second word of each pair from among five choices. 20 seconds were allotted for response time, after which the tape recorder began the next set. Set 2 in the V-A condition was auditory. The six pairs were presented orally on tape by a clear feminine voice, after which the S's were given instructions to mark answers to set 2. 20 seconds were allotted for response time. The S's were then instructed to look up at the screen and the 3rd set was begun. This procedure was extended throughout the test. For the A-V condition, the procedure was identical except that the odd numbered sets were administered auditorily and the even numbered sets visually.

The second test, the Persian Vocabulary test, consisted of 60 multiple choice items in which the S's were asked to pair one English word with one of four Persian words. S's were expected to learn which of the four Persian words was correct through a brief prior learning task comprising a Persian sentence containing the stimulus words, followed by the English equivalent, followed by the Persian sentence again. The

Persian test consisted of 20 sets, 3 items per set. Each set took 30 seconds to present either auditorily or visually and the response time allotted for answering the questions was 15 seconds per set.

The auditory items were given on the tape by a feminine Persian speaker in a clear voice and the visual items were presented for 3 seconds each by an impulse from the tape recorder synchronized with the projector.

Modality Environment Instrument (MEI)

For Experiment Two, an instrument was developed to assess the degree to which each teacher relied on auditory, visual, or combined A-V methods in his or her teaching. For this purpose, each class period was broken down into one-minute segments during which an observer watched the class for 50 seconds and then had 10 seconds in which to make a checkmark on a prepared form indicating whether the activities just observed called upon the students' auditory modality alone, visual modality alone, both modalities combined, or neither modality (taking attendance, etc.).

The one minute period of observation was used because it allowed the least amount of overlap of distinctly different activities with the minimum amount of redundancy in observations. The original times under consideration for intervals were 15 seconds (too redundant); 30 seconds (too redundant); 1 minute (used); 2 minutes (too much overlap); and 4 minutes (too much overlap). The development of the instrument was done in the SUNY-affiliated high school language classes at the Milne School in Albany, N. Y.

Inter-rater reliability data were generated for this instrument during the observation schedule for the teachers and classrooms involved in the study. Three observers made independent observations on the modality environment of each classroom. The observations were randomly made over a period of months in each classroom. Observers periodically did ratings of the same class, to check on inter-rater reliability. At

least one such check was made in each classroom. The MEI data are summarized in Table One. It can be seen that differences among teachers are slight, with the single exception of Teacher #11, whose high "neither" score reflects the fact that she spent much time in organizing and disciplining her class.

Other Measures used in Experiment One

Language Aptitude Battery
Pimsleur Modern Foreign Language Proficiency Tests, Tests 1 & 3 -
Listening Comprehension and Reading Comprehension
Final grade in foreign language
Final grade in mathematics
Final Grade in English
IQ scores - Lorge and Thorndike

Other Measures used in Experiment Two

Pimsleur Modern Foreign Language Proficiency Tests, Tests 1 & 3 -
Listening Comprehension and Reading Comprehension
Final grade in foreign language

Other Measures used in Phase 4

Student Questionnaire I

This was a list of ten statements, each intended to indicate a preference for either a visual or an auditory activity, or a sensitivity to a stimulus in one or the other modality. There were five pro-auditory and five pro-visual statements, to each of which the students were to indicate a degree of agreement or disagreement by circling one of 5 responses (SA, A, U, D, SD).

Student Questionnaire II

This questionnaire consisted of three questions. The first, the self-reported modality question, asked the student to identify himself as either eye-minded, ear-minded, or having no preference. In the

second question students were to rate their liking for each of four school subjects, three of which (science, math, & English) were considered by the investigators as generally more visual in their classroom approach than the fourth, foreign language. In the final question the students were asked to rate their preference among four FL classroom activities chosen to represent the four language skills.

Teacher Questionnaire

One questionnaire was given to the first-year FL teacher of each student in the sample. The teacher was asked to rate the student's overall attentiveness in class as compared with other students he had taught. He was also asked to rate the student's achievement as good, average, or poor in: a) listening and speaking, and b) reading and writing.

Experimental Procedures

In Experiment One (Concurrent Validity), the MEB and LAB were administered during the first part of the school year. During the last month of the school year, Pimsleur Proficiency Tests were administered. End of year final grades in foreign language were collected as were math and English final grades and IQ scores. These data were tabulated separately for auditory, visual, and no preference students.

"Difference" scores were used in classifying S's as auditory, visual, or no preference. A subject was placed in the auditory group if his auditory performance exceeded his visual performance on the MEB by at least one standard deviation. Similarly, he was placed in the visual group if his visual performance exceeded his auditory performance by at least one standard deviation. For placing the S's in auditory, visual, and no preference groups, and only for this purpose, standardized rather than raw MEB scores were used, so as to equalize the weight of the Paired Associate Test (48 items in each modality) and the Persian Vocabulary Test (30 items in each modality).

In Experiment Two (Predictive Validity), the MEB was administered to all students early in the school year. The MEI observations for teacher modality emphasis were also begun early, as were interreliability studies of the MEI. During the last month of the school year, Pimsleur Proficiency Tests were administered. End of year final grades in foreign language were collected. For purposes of data analysis, students were assigned to groups according to their modality endowment and a one-way analysis of variance performed. Multiple regressions were done to determine the contribution of modality endowment to prediction of achievement in foreign language learning.

Phase 4 was conducted in the following manner. During the winter following completion of Phase 3, questionnaires were given to selected teachers and students, and the records of the students were checked. The students were grouped as to MEB category (auditorily- and visually-endowed) and self-expressed modality preference, and these modality indicators were investigated in relation to certain performance and attitude variables.

PART III - RESULTS

Experiment One: Concurrent Validity (N=140)

Tables 2 and 3 show the data for the concurrent validity study and the analysis thereof.

It can be seen by inspecting Table 2 that there are small but consistent differences that occur across the three subject groups. Though not statistically significant, the differences show trends which give credence to the concurrent validity of the instrument in question (MEB). Inspection of Table 3 reinforces this interpretation. The significant correlations with many of the criterion variables show that the MEB is measuring some component of foreign language aptitude. The differential correlations across such key variables as IQ and Math Grades show that this cannot be attributed simply to a common IQ factor. The strong correlations of the parts of the battery with itself are a further indication of its reliability, which was demonstrated in Phase 2 of this investigation. The correlations of variables such as IQ and final grades with the LAB, are in agreement with the published norms for that instrument and give a good indication of the normalcy and generalizability of the population and the data.

Experiment Two: Predictive Validity (N=320)

The original design for this study anticipated finding three distinct types of Modality Environment. However, as Table 1 shows, this did not turn out as expected. Instead, only one environment was found, hovering between all-auditory and audio-visual. The 3 x 3 design thereby found itself reduced to a 3 x 1 design, and the results will be reported on that basis.

Inspection of Tables 4 through 6 indicates that the experimental hypothesis--that groupings with matched modalities (e.g. auditory students learning by auditory methods) will score better than groupings with unmatched modalities--has not been supported. Though there are

small differences among groups in Experiment Two, the pattern of these differences is not consistent and in some cases unmatched groups are superior to matched groups. The predictive value of modality endowment as measured by the MEB is minimal. A one-way analysis of variance was performed, and the F ratio of .147 (DF=320) showed no differences in the population sampled.

Phase 4

It was hypothesized that auditory students would express a higher degree of agreement with the pro-auditory statements on student questionnaire I than visual students, and that the latter would agree more highly with the pro-visual statements. The data in Tables 7 and 8 show that this hypothesis was not confirmed. The visual group tended to agree more with both pro-visual and pro-auditory statements. Although the differences were greater for pro-visual statements, they were not significant in either category.

It was also hypothesized that there is a significant relationship between auditory and visual modality endowment (as measured by the MEB) and self-expressed preference (eye-minded, ear-minded, no preference). While the data in Table 9 suggest some connection between these two variables, a chi-square analysis did not reveal a significant relationship. This finding is particularly damaging to a fundamental working hypotheses of this investigation, namely that student perceptions of their own modality endowments are valid and objectively measurable.

The investigators also theorized that students whose MEB scores indicate an auditory preference would drop out of FL study at a significantly lower rate, and that these students would generally be considered more attentive by their first year FL teachers. The results (Tables 10 and 11) indicate, however, that this was not the case. The dropout rates for the two groups, as well as the attentiveness ratings, were virtually identical. The dropout rate was also measured against student self-expressed modality preference, and no significant differences found. Thus, the findings of Pimsleur et al (1963) that ear-minded students

continue FL study more than eye-minded students has not been replicated.

It was hypothesized that auditorily-endowed students would express a greater liking for foreign languages (as compared with science, math, and English) than visually-endowed students. The data in Table 12 suggest that such a relationship may exist (68% of the auditory students rated FL class first or second, as compared with 48% of the visual students). A chi-square test indicated a probability slightly greater than .10 that this is a chance result.

It was theorized that students with MEB scores that identify them as auditory would express a greater liking for auditory FL class activities than visual students, who supposedly would prefer visual activities more. The results in Table 13 show that this hypothesis was not confirmed.

The investigators hypothesized that teacher ratings of eye-minded students' performance in the visual language skills (reading and writing) would be significantly higher than those of ear-minded students, and that the same would be true of ear-minded students in the auditory skills (listening and speaking). The data in Tables 14 and 15 indicate that there was little difference in the ratings of the two samples in either category.

All the foregoing hypotheses were also tested against the students' self-expressed modality preference--eye-minded, ear-minded, and no preference. The findings showed no significant differences in the three groups, except that teacher ratings of the visual skills of eye-minded students were significantly higher than their ratings of the other students on these skills (see Table 16).

PART IV - CONCLUSION AND RECOMMENDATIONS

This study originated in the everyday observation that many people make statements which show that they believe themselves to have a distinct modality predilection ("I can't learn it unless I see it in writing." "I rarely take notes, I just listen to the teacher lecture." "I appreciate art more than music; I'm very visually oriented, you know."). The validity of such statements appeared to receive empirical support in a study of underachievement in foreign language learning (Pimsleur et al, 1963), where students' self-expressed modality endowment correlated with their achievement in listening comprehension and with their intention to continue foreign language study. The present study was undertaken in the hope that modality endowment could be measured objectively, for it was felt that once such a measure was available, it would help schools to gear instruction to the individual learning styles (auditory or visual) of their students.

The results of this investigation are largely negative. A test called the Modality Endowment Battery was constructed. It was shown to be a reliable measuring device, and its concurrent validity received some confirmation from the pattern of correlation between it and other aptitude and achievement measures. However, a variety of experimental approaches failed to demonstrate its validity as a predictive tool. Neither the scores of our subjects on this test, nor their self-expressed modality preferences, showed any consistent correlation with their performance in the foreign language class.

If modality endowment were indeed an important factor in foreign language learning, it would be likely to have revealed itself in this study, in view of the variety of research strategies employed in trying to detect it. Moreover, the foreign language class, being largely auditory, is probably the school subject where the modality factor would be the most likely to display its importance. It did not do so. Hence, while we cannot rule out the possibility that this factor does exist--i.e. that some people do learn better through one modality or the other--we are obliged to

conclude that its influence on school learning in general, and foreign language learning in particular, is slight at best. Our present view, therefore, is that most students are capable of learning both auditorily and visually, regardless of any beliefs they may hold to the contrary. After two years of effort, we draw this conclusion without regret, believing it to be important as a guide to future researchers.

Stepping back from our study, and viewing it in the context of present day educational research, we believe that the welter of studies now being conducted into modality propensities, "imagery" types, and the like may well be barking up a fruitless tree.

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PART VI - APPENDICES

Appendix A:	Final Report, Phase One
Appendix B:	Final Report, Phase Two
Appendix C:	Modality Endowment Battery
Appendix D:	Modality Environment Instrument
Appendix E:	Student Questionnaire I
Appendix F:	Student Questionnaire II
Appendix G:	Teacher Questionnaire

Appendix A: Final Report on Phase One

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Paul Pimsleur and Allan Gehring
State University of New York at Albany
1400 Washington Avenue
Albany, New York 12203

MODALITY ENDOWMENT IN FOREIGN LANGUAGE LEARNING

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ABSTRACT

Four tests and a questionnaire were constructed to detect individual differences in learning efficiency through the auditory and visual modalities. Each test has an auditory and visual subtest and they contain learning materials drawn respectively from Chinese, Persian, the game of Tic Tac Toe, and English nouns arranged in paired associate format. The tests and questionnaire have been experimentally administered to small groups of seventh graders. The results suggest that two of the tests be dropped from the battery and that the reamining two tests be extended in length. They, together with the Questionnaire, will form a practical one-hour battery which is to be the subject of a subsequent reliability and validity study. It is hoped that this battery will shed light on the psychological processes underlying foreign language learning and will permit measurement of individual differences in learning rate that have not heretofore been amenable to investigation.

INTRODUCTION

The purpose of this study was to construct tests which would measure efficiency of learning in the visual and auditory sense modalities. Accordingly, fourteen tests were constructed and administered to classroom groups of seventh grade students. Through a process of editing in which auditory and visual counterpart tests were amalgamated, the original fourteen tests were reduced to a battery of four: the Chinese Test, the Persian Test, the Tic Tac Toe Test and the Paired Associate Test. In addition, a questionnaire was constructed, administered and revised in order to measure expressed preference for learning through a particular sense modality. The tests and questionnaire are explained below under Procedure. Their reliability and validity are to be determined in a subsequent phase of this project.

The relative efficiency of learning through visual and auditory modalities has been explored and debated at least since 1894. As with most comparative educational research, the findings have been largely inconsistent and nongeneralizable. Relative efficiency appears to depend on such interactive factors as 1) meaningfulness of the instructional material, 2) difficulty of the instructional material, 3) age of the learner, 4) reading speed of the learner, 5) intelligence of the learner, and 6) whether retention is measured immediately or after a delay. Day and Beach reviewed the literature up to 1950 and concluded that in terms of a box score, visual memory is generally better than auditory. But a box score of experimental outcomes is, of course, scientifically a confession of ignorance. It means the problem is complex and the conditions which produce one or another outcome must be precisely specified. Interactions of the key variable (sensory modality) with other experimental variables could account for seemingly contradictory results in different studies, as could the interaction of the key variable with subject variables, or individual differences. For example, although the majority of studies show that adults do better on visual than on auditory memory tasks, it appears that the reverse is true for

children (Abbot, 1909; Hawkins, 1897; MacDougall, 1904). And visual short-term memory has been found to decline more rapidly with age (over 40) than auditory short-term memory (McGhie, Chapman and Lawson, 1965). In brief, the question of the superiority of visual or auditory memory cannot be given a general answer that covers all conditions and types of subjects. An experimental analysis of the specific conditions that make for the superiority of one or the other is needed.

Of equal importance to the question of whether people in general learn or remember more effectively when the material is presented visually or auditorily is the question of whether some individuals favor one sensory modality over the other in learning and remembering. The first question is normative and the second is ipsative. One of the few studies investigating the second question was performed by Kay (1958). He used a paired associate test consisting of familiar words and concluded that people with individual differences in modality efficiency are atypical, relatively few in number, and the discrepancy in their performance is likely to go unnoticed. He goes on to say, however, that where the problem is to teach all members of a group, the presence of a few extreme cases will necessitate either constant use of a dual mode of presentation, or a division of the group according to its favored modality.

The question of individual differences in modality efficiency was also investigated by Jensen (1971). His failure to find significant differences as a function of sensory modality would seem consistent with the hypothesis that the stimuli, regardless of sensory channel, are encoded in a single auditory short-term memory system. Under this condition, and assuming his subjects had no primary auditory or visual defects, the only source of individual differences in auditory and visual memory would be in the effectiveness with which students transformed visual input into auditory memory traces. This can be thought of as a kind of mediation process which one could expect to be well developed among Jensen's highly screened college population. Jensen's results, therefore, cannot be generalized to other ages, widely differing levels

of intelligence, or tasks other than digit-span. It might well be that young children, the mentally retarded, the senile, and certain types of brain-damaged subjects would show marked individual differences in auditory and visual memory span. It is also entirely possible that natural foreign language materials, which present the discrepancy between a visual (written) and an auditory (spoken) system in heightened form, may bring to light modality differences that digit and native language materials were unable to detect.

Relevant research and accumulated teacher experience seem to point in the direction of appealing to as many of the senses as possible rather than insisting upon a single approach for all students regardless of their predisposition toward oral or visual means of learning. (Chastain, 1971) The teacher needs to broaden his scope of activities to include all the language skills and all student abilities. In this case, oral and written presentations can complement each other even though the transfer from one to the other may not be so great as was originally supposed. In other words, the students who do not pick up the structures and vocabulary presented orally may do so visually and vice-versa. If the initial introduction is not comprehended, additional study in the other mode may serve to reinforce the concepts being studied.

The validity phase of this investigation may be expected to throw light upon the relative strength of sense modality differences, and their relation to foreign language learning, particularly in regard to the well-known "time lag" problem as to whether written forms should be presented simultaneously with spoken forms or some time later.

PROCEDURE

The four tests were administered as a coordinated audio-visual program. The equipment used consisted of a Kodak Carousel Slide projector (Ektagraphic), a Wollensak 2525 tape recorder and existing classroom screens. Instructions and auditory subtests were all recorded on cassette tapes and visual subtests were projected from 35 mm slides. The questionnaire and all of the tests were administered to intact classroom units at the Milne School in Albany, New York. Each of the classroom units consisted of approximately 20 seventh grade boys and girls who were taking a course in a foreign language. The school administration assigns such students to courses in French, Spanish and Latin regardless of their foreign language preference. One class period was normally used to administer each test, and each testing was preceded by a brief explanation of our goals, the tests, and the need for cooperation. Each testing session was followed by a question and answer period with the students and teacher in order to benefit from their insights, attitudes, and recommendations.

All of the tests consist of equivalent (or at least similar) learning materials presented separately to the auditory and visual modalities.

In the Chinese Test, the auditory subtest is a sound discrimination task based on three variations in pitch which give the Chinese syllable "ma" several completely different meanings. The visual subtest is a recognition task in which the subject is required to discriminate one Chinese character from another, similar appearing character. There are thirty items in each subtest and the total presentation time is 15 minutes.

The Persian Vocabulary Test consists of 36 multiple choice items in which the subject is asked to pair one English word with one of four Persian words. He is expected to learn which of the four Persian words is correct on the basis of a brief prior learning task which consists

of a Persian sentence followed by its English translation, followed by the Persian sentence again. Each subtest consists of 18 vocabulary words grouped in sets of three. Visual and auditory sets are presented alternately and the total time of presentation is 20 minutes.

The Tic Tac Toe test is based on the game of that name. Subjects are instructed to visualize a Tic Tac Toe pattern in their minds and to fill in "x's and 'O's by rows from left to right and top to bottom. Alternate games are presented visually and auditorily. After each game subjects are instructed to indicate the winning combinations as Row, Column, Diagonal; Row and Column; Row and Diagonal; or Both Diagonals. Time of presentation is approximately 30 minutes.

The Paired Associate Test utilizes one of the most versatile and best known methods of measuring verbal behavior. Associated material has traditionally consisted of English nouns, CVC trigrams, and two syllable paralogs; e.g. Regut. Our test contains material of all three types and should therefore yield more generalizable results. Each subtest consists of 48 associates grouped in sets of 6. After each set the subjects are asked to identify the second word of each pair from among five choices. Alternate sets are visual and auditory. Time of presentation is 18 minutes.

The Questionnaire consists of ten statements which indicate a preference for the auditory or visual modality. Alternate statements favor each modality and subjects are instructed to respond to each statement by marking SA, A, U, D or SD (Strongly Agree, agree, undecided, disagree, or strongly disagree). As a check on reliability the two most relevant items (1 and 6; 4 and 9) are repeated twice so that each appears in a statement favoring each modality. The questionnaire takes about five minutes to complete

RESULTS AND DISCUSSION

Table 1 presents a statistical profile of the tests based on the number of students (N) they were administered to. Most important are the mean scores for each subtest, because individual differences between subtest scores may be meaningless if the learning materials in each subtest are not equivalent. Although many other factors can interact and contribute to mean score variance, those factors have been controlled in so far as is possible. Therefore, the equivalence or non-equivalence of the mean scores can be taken as a reasonable estimate of the equivalence or non-equivalence of learning materials.

TABLE 1

STATISTICAL PROFILE OF THE TESTS

	Chinese		Persian		Tic-Tac-Toe		P-Associate	
	Vis	Aud	Vis	Aud	Vis	Aud	Vis	Aud
MEAN	23.67	16.05	15.41	12.93	5.95	6.00	35.22	32.33
NO. ITEMS	30.	30.	18.	18.	10.	10.	48.	48.
HIGH SCORE	27.	22.	18.	17.	10.	9.	46.	42.
LOW SCORE	19.	10.	11.	6.	2.	2.	14.	10.
RANGE	9.	13.	8.	12.	9.	8.	33.	33.
STAND. DEV.	2.50	2.99	1.97	3.00	1.96	1.79	8.15	8.87
STAND. ERROR	1.99	2.56	1.37	1.72	1.43	1.46	2.60	2.64
RELIABILITY	.01	.57	.61	.73	.41	.06	.93	.94
N	21	21	27	27	21	21	18	18

The non-equivalence of the Chinese characters (visual) and the Chinese pitch material (auditory) is reflected by the drastic difference (7.62 points out of 30) between the mean scores on these two subtests. This difference has persisted despite attempts to equate these tests by reducing the presentation time on the visual subtest and improving the clarity of the auditory subtest.

The data for the Persian test, on the other hand, are more satisfactory. The Persian and English sentences in the visual and auditory subtests appear to be equivalent in terms of their mean subtest scores. (The difference between them is only 2.48 points out of 18). This reflects the fact that the Persian language uses the Roman alphabet, and hence lends itself to equivalent presentation in the two modalities.

The mean scores of the TIC TAC TOE subtests are almost identical, reflecting the obvious equivalence of 'X's and 'O's presented in each modality. The Paired Associate subtests also reflect a very high degree of equivalence, showing a difference of only 2.89 points out of 48.

Also shown in Table 1 are the split-half reliability estimates for each subtest. Being based on a very small sample, they can be considered merely as guides to possible improvement of the battery, as a prelude to the more extensive reliability study to be undertaken in the next phase.

Observation of the reliability estimates in Table 1 reveals that the Chinese Test and the TIC TAC TOE Test are low, particularly the visual Chinese subtest (.01) and the auditory TIC TAC TOE subtests (.06). It is questionable whether these tests would profit from further revision; they may be dropped from the battery.

The reliability estimates for the Persian subtests are high enough to justify attempts to improve them (.61 and .73). They suggest that with some lengthening, this test will attain quite satisfactory reliability.

The reliability estimates for both Paired Associate subtests are, without qualification, excellent (.93 and .94), suggesting that they require no further revision.

One additional problem indicated by the data is that, with the exception of the TIC TAC TOE Test, the range and standard deviation of all the auditory subtests is greater and the mean scores lower than their visual counterparts. Additional clarity and volume for the

auditory subtests may be the solution to this problem.

The data collected on the Questionnaire indicate that 15 people out of 18 had non-equivalent auditory and visual preference scores. Only 5 of those 15 people, however, had a difference between their preference subscores of 3 or more points out of 10. The reliability of the Questionnaire is suggested by the fact that only 2 people out of 18 contradicted themselves between items 1 and 6 or items 4 and 9.

CONCLUSIONS

In the light of these results it appears possible to reduce the battery to a more practical and workable form. A battery consisting of the Persian and Paired-Associate tests would take no more than one hour to administer, would include a sufficient number of items to discriminate modality proclivities along a wide range of ability levels, and would possess face validity by virtue of its verbal and foreign content. Such a battery, plus the Questionnaire, would provide a 3-way measurement strategy: 1) self-report of modality endowment (Questionnaire); 2) modality endowment measured through artificial verbal materials (Paired Associates); 3) modality endowment measured through natural language materials (Persian). The apparent reliability, and potential validity of this measurement approach promises to provide a useful instrument by means of which to further explore sense modality endowment, its extent, and its significance for improving the teaching of foreign languages.

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Appendix B: Final Report on Phase Two

This report concerns the second part of a three part study of auditory and visual modality endowment. In the first phase, two tests were developed for measuring learning efficiency in the two sense modalities. The object of the second phase has been to establish the reliability of these two instruments.

The project was initiated as a result of the principal investigator's experience and research in the field of language learning. He had noted the need for a better understanding of individual differences in learning style among students of foreign languages, and had discovered during a previous research project that modality endowment was an influential variable that had thus far escaped the attention of foreign language educators.

Other authors, such as Coulson, Silberman, Osgood, Hebb and Penfield have also stressed the need for research in this area. Burt, for example, after collecting thousands of test results, maintains that "sensory imagery" does vary greatly and that individual preferences can be established. In light of this, he asks for increased engagement in research which considers predominances and individual differences.

Over the years, a large amount of literature has accumulated on the subject of differential learning and retention in various sense modalities. The total effect of this experimental literature is at best confusing, for the findings of one group indicate superior auditory memory, while others have found visual memory superior to auditory. As Jensen wrote:

> Day and Beach (1950) who reviewed the entire literature up to 1950 concluded that, in terms of a box score, visual memory is generally better than auditory. But a box score of experimental outcomes is, of course, scientifically a confession of ignorance. It means the problem is complex and the conditions that produce one or another outcome must

be precisely specified. Interactions of the key variable (sensory modality) with other experimental variables could account for seemingly contradictory results in different studies, as could the interaction of the key variable with subject variables or individual differences.

When Jensen (1971) investigated individual differences in modality efficiency, he failed to find significant differences. His failure may in large measure result from the highly screened nature of his experimental population. His subjects represent the top 10% of all high school students in America, and his results may, therefore, not generalize to a wider cross section of the population. Jensen did, however, set forth with clarity the experimental design necessary for finding significant differences in sensory modality endowment; and as much as practicable, this study has endeavored to comply with his stringent methodological demands.

SUBJECTS

The subjects were the entire 6th grade population of the North Colonie Central Schools, ranging in age from 11 to 13 years. They were randomly assigned class by class, to one of two groups.

Group 1 (N=191) received the stimuli in a visual-auditory order.

Group 2 (N=175) received the identical stimuli in an auditory-visual order.

PROCEDURE AND MATERIALS

The two tests were administered as a coordinated audio-visual program. The equipment used was a Wollensak 2550 AV tape recorder and a Kodak (ekta-graphic) Carousel Slide Projector with zoom lens. The auditory stimuli and all instructions were presented by the tape recorder. Two experimenters were present to answer S's questions during pre-arranged pauses in the instructions on the tape. The visual stimuli were triggered by tape recorded impulses. The time for both presentations was controlled so that the

auditory and visual stimuli were presented for the same period of time. The answer sheets were constructed in booklet form with instructions on the tape recorder telling S's when to turn pages and where to mark answers. Time for adminstration of both tests was approximately 50-60 minutes.

The Paired Associate Test consisted of 96 pairs of items presented in 16 sets of 6 pairs each. The 16 sets were administered in alternate auditory or visual order. In the VA condition for example, the first 6 stimulus pairs were presented visually by the automated equipment (2 seconds per stimulus pair; total time for presentation, 15 seconds). After the presentation of the stimuli, the S's were instructed to turn to the appropriate answer sheet and mark their answers to set #1. Their task was to identify the second word of each pair from among five choices. A response time of 20 seconds was allotted, at the end of which the tape recorder began the next set. Set #2 in the VA condition was auditory. The six stimulus pairs were presented on tape orally by a clear feminine voice after which the S's were given instructions to turn to a particular page in the answer booklet and to mark answers to set #2. Again, twenty seconds were allotted for response time, at the end of which the S's were instructed to look up at the screen and the third set was begun. This procedure continued throughout the test with all odd numbered sets in the VA condition being administered visually and all even numbered sets administered auditorily. For the AV condition (Group II), the procedure was identical except that the odd numbered sets were administered auditorily, and the even numbered sets were administered visually. The identical stimulus pairs were used in set one in both conditions; similarly in set two and in all the sets.

The Persian Vocabulary Test consisted of 60 multiple choice items in which the S's were asked to pair one English word with one of four Persian words. S's were expected to learn which of the four Persian words was correct through a brief prior learning task which consisted of a Persian sentence containing the stimulus word, followed by the English translation, followed by the Persian sentence again. The Persian test consisted of 20 sets of 3 items. Each set took 30 seconds to present either auditorily or visually, and the response time allotted for answering the questions was 15 seconds per set. The auditory items were given on the tape by a native speaker of Farsi in a clear feminine voice, and the visual items were presented for three seconds each by means of an impulse from the tape recorder synchronized with the Kodak Carousel Slide Projector. In all other respects, the presentation was the same for Paired Associate and Persian Vocabulary Tests, differing only in order of presentation of auditory and visual stimuli in condition AV or VA.

RESULTS AND DISCUSSION

Table #1 presents a statistical profile of the tests. The mean scores on subtests are important, because individual differences between subtest scores may be meaningless if the learning materials are not equivalent. As the many factors that may contribute to mean score variance have been controlled for insofar as possible, the equivalence of mean scores can be taken as a reasonable estimate of the equivalence of learning materials.

TABLE #1

PERSIAN VOCABULARY TEST

	GROUP I - VA			GROUP II - AV		
	V	A	VA	V	A	AV
# of Items	30	30	60	30	30	60
High Score	30	29	57	27	27	54
Low Score	5	3	8	8	3	14
Range	26	27	50	20	25	41
Mean	18.5	14.0	32.5	18.2	13.8	31.9
Std. Dev.	5.4	4.8	9.1	4.7	4.9	8.5
Std. Error	2.36	2.48	3.45	2.35	2.50	3.45
Rel. KR 20	.81	.73	.86	.76	.74	.84
r_{av} or r_{va}	.58			.56		
r_{diff}	.48			.43		

PAIRED ASSOCIATE TEST

	GROUP I - VA			GROUP II - AV		
	V	A	VA	V	A	AV
# of Items	48	48	96	48	48	96
High Score	43	41	83	45	41	82
Low Score	4	6	14	2	0	4
Range	40	36	70	44	42	79
Mean	27.8	24.6	52.5	30.2	23.9	54.1
Std. Dev.	7.7	7.1	13.2	8.5	7.6	14.7
Std. Error	3.12	3.18	4.48	2.98	3.12	4.35
Rel. KR 20	.84	.80	.89	.83	.88	.91
r_{av} or r_{va}	.60			.65		
r_{diff}	.55			.58		

It can be seen by visual inspection of Table #1 that the differences are slight between mean scores within modality across groups, while the differences are sizeable across modalities within groups. The scores across groups within modality confirm the equivalence of the learning material and the lack of an ordering effect in the AV or VA conditions. The differences across modality on the equivalent learning material show strong differences according to sense modality performance. In both the Persian Vocabulary Test and the Paired Associate task this performance difference for the group shows a more efficient processing of information in the visual domain.

These impressions were confirmed statistically by a one-way analysis of variance. All the differences across modality were significant beyond $P<.001$. Only one of the differences within modality approached significance (Paired Associate Test, visual task); all other comparisons within modality were non-significant.

Our chief concern is reliability. As Table I shows, the reliabilities for both full length tests are very strong, (.89 and .91), demonstrating that these tests possess a high degree of internal consistency. The reliabilities of the subtests were .81 on Persian VA visual; .73 on Persian VA auditory; .76 on Persian AV visual, and .74 on Persian AV auditory. The high reliabilities of the subtests may make possible their diagnostic use in establishing a "modality profile" for individual students; this possibility will be followed up in the next phase of the study.

Turning to the reliability of modality differences, Thorndike's computation, $r_{diff} = \frac{\frac{r_{11}+r_{22}}{2}}{1-r_{av}}$, was used to compute the reliability of difference scores for the cross modality measures. This computation yielded a reliability of

difference of .48 in the VA condition and a reliability of difference of .43 for AV condition. Though not nearly as high as the reliabilities of the tests or subtests, these reliabilities of difference may prove to be a substantial contribution to diagnosis of differences of modality endowment. The Paired Associate subtests produced higher subtest reliabilities, and therefore, the reliability of the difference scores was much stronger (r-diff. in VA = .55 and r-diff. in AV = .58).

To examine the contribution of each item, an item analysis was done on each subtest. Table #2 presents a rough composite of the distributions of the discrimination index for the items according to their cells in the experimental design.

TABLE #2

DISCRIMINATION INDEX

	-0	0-09	10-19	20-29	30-39	40-49	50-59	60
PA AV	1	3	14	24	29	21	3	1
PA VA	0	2	10	23	27	31	3	0
PERS VA	0	3	1	17	21	15	3	0
PERS AV	0	4	9	13	16	13	4	1

More than 60 percent of the items in the test showed discrimination power above .30, and only one item of the 312 sampled in the four test situations showed a minus discrimination. The items in the range of 0-19 may be improved with editing in the future.

Of the 366 subjects sampled, inspection and comparison of their scores on each of the subtests shows 92 S's had strong visual modality efficiency, 109 S's had weaker but still identifiable visual modality efficiency, 138 S's showed no preference and performed equally in each modality, 18 S's showed an identifiable auditory modality efficiency, and five subjects showed a strong auditory modality efficiency.

All conclusions drawn in this phase must be tentative hinging on the outcome of Phase Three, which is the validity phase of this study. At present it can be stated, however, that the tests developed possess a high degree of reliability. They show marked promise both as predictive and as diagnostic instruments for measuring modality endowment.

The next phase will evaluate predictive and construct validity, as well as face validity and will also evaluate the tests' ability to show individual differences in modality endowment.

Appendix C: Modality Endowment Battery

Part 1: Paired Associate Test

PAGE 1

NAME_____
AGE_____
SEX_____
TEACHER_____
DATE_____
CODE_____

EXAMPLE

1. Cup	A. Book	B. Tree	C. Pipe	D. Bell	E. Sock

PAGE 2

SAMPLE SET #1

1. Tray	A. Fox	B. Fish	C. Switch	D. Handle	E. Cap
2. Fire	A. Dish	B. Saucer	C. Platter	D. Finger	E. Window
3. Train	A. Belt	B. Blanket	C. Sack	D. Bone	E. Shop
4. Candle	A. Lathe	B. Dog	C. Wave	D. Shirt	E. Sheet
5. House	A. Soup	B. Belt	C. Dial	D. Boat	E. Blood
6. Apple	A. Cabin	B. Gear	C. Wreath	D. Jug	E. Toy

SET #3

13. Pail	A. Bush	B. Bug	C. Piano	D. Wind	E. Grass
14. Mop	A. Jam	B. Bud	C. Cone	D. Mouse	E. Bench
15. Bed	A. Fish	B. Bus	C. Blood	D. Mouse	E. Actor
16. Fat	A. Car	B. Nerve	C. Beaver	D. Sheet	E. Knife
17. Fool	A. Lady	B. Drape	C. Snake	D. Music	E. Blanket
18. Light	A. Foul	B. Man	C. Sofa	D. Turtle	E. Ballet

SET #7

37. Bop	A. Cot	B. Doc	C. Doz	D. Fay	E. Gab
38. Bam	A. Cad	B. Cob	C. Coy	D. Deb	E. Bel
39. Bog	A. Bon	B. Cal	C. Dec	D. Dub	E. Dum
40. Cud	A. Din	B. Dun	C. Gam	D. Gil	E. Gov
41. Bah	A. Bev	B. Bil	C. Cox	D. Dem	E. Dic
42. Bas	A. Bos	B. Cam	C. Cit	D. Cut	E. Cuz

SET #11

61. Haken	A. Fox	B. Fish	C. Switch	D. Handle	E. Cap
62. Gelip	A. Dish	B. Saucer	C. Finger	D. Window	E. Platter
63. Hikow	A. Belt	B. Sack	C. Bone	D. Shop	E. Blanket
64. Mekut	A. Lathe	B. Dog	C. Wave	D. Shirt	E. Sheet
65. Bulex	A. Soup	B. Belt	C. Dial	D. Boat	E. Blood
66. Seger	A. Cabin	B. Gear	C. Toy	D. Jug	E. Wreath

SET #15

85. Hikum	A. Bush	B. Bug	C. Piano	D. Wind	E. Grass
86. Reben	A. Jam	B. Bud	C. Cone	D. Mouse	E. Bench
87. Sobol	A. Fish	B. Bus	C. Blood	D. Mouse	E. Actor
88. Jugar	A. Car	B. Nerve	C. Beaver	D. Sheet	E. Knife
89. Tarat	A. Lady	B. Drape	C. Snake	D. Music	E. Blanket
90. Capul	A. Foul	B. Man	C. Sofa	C. Turtle	E. Ballet

SAMPLE SET #2

7. Bike	A. Sauce	B. Teacher	C. Elbow	D. Corn	E. Rat
8. Ring	A. Ankle	B. Pan	C. Priest	D. Card	E. Bundle
9. Leg	A. Plate	B. Pastor	C. Potato	D. Pot	E. Building
10. Foot	A. Bread	B. Letter	C. Fork	D. Baby	E. Rabbi
11. Girl	A. Elbow	B. School	C. Milk	D. Boy	E. Cake
12. Fork	A. Thief	B. Wing	C. Boy	D. Head	E. Office

SET #4

19. Liver	A. Carton	B. Mink	C. Elephant	D. Dance	E. Beach
20. Truck	A. Bone	B. Poem	C. Butter	D. Pail	E. Nose
21. Bag	A. Signal	B. Child	C. Snow	D. Tooth	E. String
22. Tin	A. Doctor	B. Soda	C. Sun	D. Yarn	E. Kite
23. Rain	A. Thread	B. Cable	C. Nurse	D. Hand	E. Bible
24. Face	A. Sleet	B. Needle	C. Toast	D. Silver	E. Lawyer

SET #8

43. Gym	A. Hem	B. Hen	C. His	D. Hub	E. Jaw
44. Fab	A. Gad	B. Git	C. Gob	D. Gus	E. Hey
45. Fir	A. Hun	B. Lit	C. Lux	D. Mut	E. Nab
46. Hel	A. Jaz	B. Jil	C. Jog	D. Jud	E. Kix
47. Dil	A. Dol	B. Fag	C. Fuz	D. Haz	E. Hew
48. Fel	A. Fil	B. Hav	C. Kis	D. Laf	E. Lin

SET #12

67. Linex	A. Sauce	B. Teacher	C. Elbow	D. Corn	E. Rat
68. Regut	A. Ankle	B. Pan	C. Priest	D. Card	E. Bundle
69. Lasim	A. Plate	B. Pastor	C. Potato	D. Pot	E. Building
70. Himov	A. Bread	B. Letter	C. Fork	D. Baby	E. Rabbi
71. Bacar	A. Elbow	B. School	C. Milk	D. Boy	E. Cake
72. Coger	A. Thief	B. Wing	C. Boy	D. Head	E. Office

SET #16

91. Sagus	A. Carton	B. Mink	C. Elephant	D. Dance	E. Beach
92. Jamig	A. Bone	B. Poem	C. Butter	D. Pail	E. Nose
93. Rotak	A. Signal	B. Child	C. Snow	D. Tooth	E. String
94. Samaj	A. Doctor	B. Soda	C. Sun	D. Yarn	E. Kite
95. Sonol	A. Thread	B. Cable	C. Nurse	D. Hand	E. Bible
96. Tedun	A. Sleet	B. Needle	C. Toast	D. Silver	E. Lawyer

PAGE 4

SET #1

1. Map	A. Hand	B. Mask	C. Hut	D. Beer	E. Banana
2. Snow	A. Cab	B. Cart	C. Foot	D. Food	E. Chain
3. Store	A. Boot	B. Lab	C. Lad	D. Child	E. Knee
4. Door	A. Paper	B. Bead	C. Pig	D. Coat	E. Car
5. Wax	A. Crayon	B. Goal	C. Cow	D. Tie	E. Vine
6. Rug	A. Tree	B. Pit	C. Ink	D. Chin	E. Glass

SET #5

25. Jam	A. Jet	B. Jew	C. Jim	D. Job	E. Joy
26. Jug	A. Kay	B. Ken	C. Kit	D. Lab	E. Joy
27. Lap	A. Law	B. Let	C. Liz	D. Log	E. Lot
28. Mad	A. Map	B. Mat	C. May	D. Med	E. Meu
29. Ban	A. Bar	B. Bat	C. Bay	D. Bed	E. Beg
30. Bad	A. Bag	B. Bel	C. Ben	D. Big	E. Bid

SET #9

49. Bom	A. Bor	B. Com	C. Cum	D. Dix	E. Dor
50. Bac	A. Bal	B. Bur	C. Caw	D. Cel	E. Cur
51. Bul	A. Caf	B. Cid	C. Dat	D. Dik	E. Dov
52. Cig	A. Dav	B. Dos	C. Fud	D. Gyp	E. Hym
53. Buc	A. Cog	B. Cor	C. Dar	D. Def	E. Hec
54. Buf	A. Cuf	B. Gip	C. Hol	D. Kup	E. Lyn

SET #13

73. Kafum	A. Hand	B. Mask	C. Hut	D. Beer	E. Banana
74. Dowab	A. Cab	B. Cart	C. Foot	D. Food	E. Chain
75. Darup	A. Boot	B. Lab	C. Lad	D. Child	E. Knee
76. Duker	A. Paper	B. Bead	C. Pig	D. Coat	E. Car
77. Givak	A. Crayon	B. Goal	C. Cow	D. Tie	E. Vine
78. Makel	A. Tree	B. Pit	C. Ink	D. Chin	E. Glass

PAGE 5

SET #2

7. Chair	A. Knife	B. Sheath	C. Foot	D. Loaf	E. Hand
8. Leaf	A. Love	B. Table	C. Pencil	D. Ball	E. Bowl
9. Light	A. Spoon	B. Lake	C. Chop	D. Sand	E. Sky
10. Sky	A. Spoon	B. Comics	C. Rabbit	D. Salt	E. Shoulder
11. Pepper	A. Water	B. Steak	C. Cartoon	D. Knee	E. Chicken
12. Crate	A. Neck	B. Hen	C. Song	D. Wave	E. Storm

SET #6

31. Pub	A. Ram	B. Rat	C. Ray	D. Rib	E. Rip
32. Sag	A. Sam	B. Sap	C. Saw	D. Sex	E. Sir
33. Sob	A. Son	B. Sum	C. Tab	D. Tag	E. Tap
34. Tar	A. Ted	B. Tex	C. Tin	D. Tip	E. Top
35. Bet	A. Bin	B. Bit	C. Boy	D. Bud	E. Bum
36. Bow	A. Box	B. Bud	C. Bus	D. But	E. Buy

SET #10

55. Ful	A. Hap	B. Kar	C. Kil	D. Lev	E. Lob
56. Dul	A. Haw	B. Hom	C. Hor	D. Huf	E. Jif
57. Duc	A. Fem	B. Fiz	C. Fus	D. Gop	E. Hac
58. Giv	A. Hed	B. Jac	C. Jed	D. Jin	E. Kic
59. Hic	A. Hoc	B. Jef	C. Jen	D. Jip	E. Las
60. Mac	A. Mol	B. Nik	C. Ros	D. Ser	E. Sez

SET #14

79. Gipan	A. Love	B. Table	C. Pencil	D. Ball	E. Bowl
80. Domik	A. Knife	B. Sheath	C. Foot	D. Loaf	E. Hand
81. Holop	A. Spoon	B. Lake	C. Chop	D. Sand	E. Sky
82. Kapub	A. Spoon	B. Comic	C. Shoulder	D. Rabbit	E. Salt
83. Robew	A. Water	B. Steak	C. Cartoon	D. Knee	E. Chicken
84. Hitit	A. Neck	B. Hen	C. Song	D. Wave	E. Storm

Part 2: Persian Vocabulary Test

PAGE 1

NAME_____
AGE_____
SEX_____
TEACHER_____
DATE_____
CODE_____

EXAMPLE

child	A. gorbe	B. bache	C. sheneed	D. ast

PAGE 2

SAMPLE SET #1

1. meat	A. gorbe	B. goosht	C. khook	D. koochak
2. wine	A. sharab	B. khalkhal	C. parastar	D. servatmand
3. knife	A. sefeed	B. sheneed	C. kard	D. asb

SET #3

7. horse	A. rand	B. zan	C. asb	D. ast
8. dog	A. goraz	B. sag	C. sharab	D. nokar
9. pig	A. bood	B. khord	C. rand	D. khook

SET #7

19. lively	A. zerang	B. khalkhal	C. rand	D. khord
20. spotted	A. parastar	B. pezeshk	C. bache	D. khalkhal
21. black	A. rahrah	B. peer	C. raseed	D. seeyah

SET #11

31. man	A. mard	B. nan	C. kard	D. zard
32. boy	A. sharab	B. pezeshk	C. pesar	D. raseed
33. doctor	A. meeve	B. pezeshk	C. peer	D. fagheer

SET #15

43. dog	A. gav	B. goraz	C. taze	D. sag
44. sees	A. meebeenad	B. doostdasht	C. servatmand	D. gorbe
45. big	A. sharab	B. bozorg	C. javan	D. parastar

SET #19

55. likes	A. doostdarad	B. zan	C. bozorg	D. zard
56. spotted	A. zerang	B. khalkhal	C. tanbal	D. deed
57. lively	A. taze	B. dokhtar	C. zerang	D. rahrah

PAGE 3

SAMPLE SET # 2

4. bread	A. ast	B. bozorg	C. nan	D. kard
5. fruit	A. pezeshk	B. bache	C. meeve	D. bood
6. book	A. dokhtar	B. deed	C. gorbe	D. ketab

SET #4

10. cow	A. sefeed	B. goraz	C. gav	D. pesar
11. cat	A. gorbe	B. khoob	C. sheneed	D. tanbal
12. sheep	A. zerang	B. goosfand	C. asb	D. ast

SET #8

22. lazy	A. tanbal	B. mard	C. rand	D. zard
23. striped	A. khord	B. rahrah	C. sag	D. goraz
24. white	A. ketab	B. seeyah	C. sefeed	D. goosht

SET #12

34. woman	A. zan	B. nan	C. zerang	D. taze
35. girl	A. bache	B. dokhtar	C. zan	D. bood
36. nurse	A. zard	B. bozorg	C. parastar	D. zerang

SET #16

46. cow	A. goosht	B. gav	C. goraz	D. nokar
47. saw	A. kard	B. peer	C. deed	D. ketab
48. little	A. pesar	B. khalkhal	C. pezeshk	D. koochak

SET #20

58. liked	A. fagheer	B. raseed	C. gav	D. doostdasht
59. lazy	A. tanbal	B. bood	C. goosfand	D. goosht
60. striped	A. sag	B. rahrah	C. seeyah	D. javan

PAGE 4

SET #1

1. man	A. goosfand	B. javan	C. mard	D. pesar
2. boy	A. khook	B. ketab	C. kard	D. pesar
3. doctor	A. koochak	B. khalkhal	C. bache	D. pezeshk

SET #5

13. rich	A. khoob	B. goraz	C. servatmand	D. bozorg
14. big	A. bood	B. khoob	C. gorbe	D. bozorg
15. young	A. javan	B. goosfand	C. nokar	D. ketab

SET #9

25. sees	A. sefeed	B. khoob	C. ast	D. meebeenad
26. hears	A. meeshnavad	B. mard	C. servatmand	D. nan
27. likes	A. sheneed	B. doostdarad	C. zan	D. meeve

SET #13

37. horse	A. deed	B. tanbal	C. dokhtar	D. asb
38. pig	A. khook	B. taze	C. fagheer	D. rahrah
39. young	A. raseed	B. javan	C. gav	D. sag

SET #17

49. hears	A. meeshnavad	B. nan	C. khoob	D. nokar
50. rich	A. mard	B. servatmand	C. khook	D. meebeenad
51. black	A. sharab	B. seeyah	C. fagheer	D. raseed

PAGE 5

SET #2

4. woman	A. goosht	B. parastar	C. meeve	D. zan
5. girl	A. dokhtar	B. rahrah	C. mard	D. rand
6. nurse	A. sag	B. parastar	C. ast	D. bood

SET #6

16. poor	A. nokar	B. javan	C. khook	D. fagheer
17. little	A. khord	B. koochak	C. taze	D. zard
18. old	A. koochak	B. pesar	C. peer	D. khord

SET #10

28. saw	A. ketab	B. taze	C. deed	D. sharab
29. heard	A. zard	B. seeyah	C. tanbal	D. sheneed
30. liked	A. doostdasht	B. nokar	C. kard	D. khoob

SET #14

40. cow	A. nan	B. gav	C. khoob	D. rand
41. sheep	A. doostdarad	B. goosht	C. goosfand	D. seeyah
42. old	A. goosfand	B. sefeed	C. goraz	D. peer

SET #18

52. heard	A. khord	B. meeshnavad	C. sheneed	D. koochak
53. poor	A. meeve	B. peer	C. fagheer	D. raseed
54. white	A. meeve	B. asb	C. bache	D. sefeed

Appendix D: Modality Endowment Instrument

Date _____

School _____

Class _____

Observer _____

Time in 1 min. int.	Vis.	Aud.	Aud. & Vis.	Neither
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				

Time in 1 min. int.	Vis.	Aud.	Aud. & Vis.	Neither
26				
27				
28				
29				
30				
31				
32				
33				
34				
35				
36				
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				

Appendix E: Student Questionnaire I

In the box are five ways you might feel about a statement. Notice that in front of each way that you might feel is a letter code (SA, A, U, D, or SD). You will use this code to show how you feel about each statement.

SA - Strongly Agree
A - Agree
U - Undecided
D - Disagree
SD - Strongly Disagree

After you have decided how you feel about each statement, circle the letter code which represents your answer. If you strongly disagreed with the statement in the following example you would circle the letters SD.

Example: I would rather be an artist than a musician. SA A U D (SD)

Please be sure to answer every statement. Do not skip or miss any. You may begin.

1. I can learn new words better by reading them than by hearing them. SA A U D SD
2. When I am not sure what a new word means I would rather ask someone than look it up in a dictionary. SA A U D SD
3. If I could listen to a story or read the same one, I would rather read it. SA A U D SD
4. I can remember a person's name better if I hear it than if I see it in writing. SA A U D SD
5. I prefer to give oral foreign language class presentations rather than written ones. SA A U D SD

6.	I would rather study a lesson by reading a book than by listening to a record.	SA	A	U	D	SD
7.	I find bright lights more distracting than loud noises.	SA	A	U	D	SD
8.	I can remember a list of three or four things without having to write it down.	SA	A	U	D	SD
9.	I can never learn the words to popular songs the way other people do.	SA	A	U	D	SD
10.	I do not find that having a light on in my room keeps me from sleeping.	SA	A	U	D	SD

Appendix F: Student Questionnaire II

Name _____

PLEASE ANSWER ALL THREE QUESTIONS.

1) I would characterize myself as: (Choose one)

___ eye-minded
___ ear-minded
___ no preference

2) How would you rate your liking for each of the following subjects? Give a 1 to your favorite, a 2 to your next favorite, and so on.

___ science
___ foreign language
___ English
___ math

3) Which activities in your foreign language do you enjoy most? Give a 1 to your favorite, a 2 to your next favorite, and so on.

___ listening to the teacher talk to the class in the foreign language
___ doing oral grammar drills
___ reading stories in the foreign language
___ doing written grammar exercises

Appendix G: Teacher Questionnaire

_____

Name of student

1) Compared with others you have taught, how attentive was this student in class?

Very Attentive		Average		Very Inattentive

2) Compared to other students you have taught, how would you rate this student's achievement in each of these two categories?

	good	average	poor
a) Listening and speaking			
b) Reading and writing			

TABLE 1

Percent of Class Time spent by Teachers in Auditory, Visual, Audio-visual, or "neither" Activities, as Measured by the MEI

Teacher No.	Times Observed	% Aud	% Vis	% Aud-Vis	% Neither	Inter-Rater Reliability
1	8	38.2	6.6	51.5	3.7	.96
2	8	38.0	1.3	59.4	1.3	.94
3	9	36.7	1.6	60.1	1.6	.89
4	9	37.5	3.3	49.2	0	.92
5	8	34.3	5.5	54.7	5.5	.96
6	6	40.7	9.6	46.1	3.6	.91
7	11	35.5	9.3	53.0	2.2	.94
8	5	40.2	2.5	52.4	4.9	.91
9	5	36.3	4.1	55.2	4.4	.95
10	5	40.1	4.7	49.2	6.0	.89
11	6	36.1	4.3	42.6	17.0	.86
12	6	42.3	3.3	42.6	1.8	.95
13	6	38.1	4.2	55.5	2.2	.94

TABLE 2

Means and Standard Deviations of 11 Concurrent Validity Measures, by MEB Group

	Variable	Auditory (N=22) Mean	S.D.	No Pref. (N=94) Mean	S.D.	Visual (N=24) Mean	S.D.
1	Persian Vocab., Visual	19.13	4.6	22.08	4.8	23.6	4.1
2	Persian Vocab., Auditory	21.00	4.3	19.57	4.0	16.16	4.5
3	Paired Nouns, Visual	27.81	7.9	33.69	6.5	36.58	4.5
4	Paired Nouns, Auditory	31.18	6.8	30.13	7.0	27.04	5.4
5	Proficiency Test: Listening	17.65	6.1	19.01	5.9	18.26	4.5
6	Proficiency Test: Reading	13.15	5.8	14.5	6.0	12.54	4.1
7	Final Grade, Language	78.86	11.5	81.86	11.0	80.41	10.2
8	Language Aptitude Battery	63.09	12.5	65.89	13.7	69.37	13.4
9	Final Grade, Math	89.63	10.9	89.13	11.6	88.04	10.3
10	Final Grade, English	79.54	8.5	83.83	8.7	82.91	8.3
11	IQ (Lorge-Thorndike)	113.25	10.5	114.15	11.9	115.09	9.1

TABLE 3

Correlations among 11 Concurrent Validity Measures

		1	2	3	4	5	6	7	8	9	10
1	Persian Vocab., Visual										
2	Persian Vocab., Auditory	*** .665									
3	Paired Nouns, Visual	*** .446	*** .354								
4	Paired Nouns, Auditory	*** .479	*** .462	*** .600							
5	Proficiency Test: Listening	.047	.090	* -.192	-.103						
6	Proficiency Test: Reading	.004	-.009	.054	.057	*** .576					
7	Final Grade, Language	* .163	.120	.112	.058	*** .523	*** .459				
8	Language Aptitude Battery	*** .497	*** .384	*** .314	*** .233	.004	* .185	*** .489			
9	Final Grade, Math	*** .371	*** .349	*** .257	*** .313	** -.213	-.073	* .177	*** .488		
10	Final Grade, English	*** .269	** .209	* .176	* .092	** .230	*** .378	*** .621	*** .573	*** .293	
11	IQ (Lorge-Thorndike)	*** .445	*** .263	*** .304	*** .231	** .236	.138	.063	*** .394	*** .493	.01

* Prob. < .05

** Prob. < .01

*** Prob. < .001

TABLE 4

Means and Standard Deviations on 7 Predictive Validity Measures, by MEB Group

	Variable	Auditory (N=52) Mean	S.D.	No Pref. (N=219) Mean	S.D.	Visual (N=49) Mean	S.D.
1	Persian Vocab., Visual	18.38	4.2	21.68	4.8	20.73	3.9
2	Persian Vocab., Auditory	20.57	4.3	18.68	4.5	13.20	3.7
3	Paired Nouns, Visual	27.94	8.0	33.51	7.1	35.08	5.7
4	Paired Nouns, Auditory	30.76	7.5	29.22	7.7	22.36	6.9
5	Proficiency Test: Listening	17.08	5.6	18.55	5.9	15.21	4.5
6	Proficiency Test: Reading	11.43	5.0	13.03	6.0	11.22	3.5
7	Final Grade, Language	82.88	11.4	83.31	11.2	84.02	11.2

TABLE 5

Correlations among 7 Predictive Validity Measures, by MEB Group

	1	2	3	4	5	6
Auditory Group						
1 Persian Vocab., Visual						
2 Persian Vocab., Auditory	.829					
3 Paired Nouns, Visual	.543	.581				
4 Paired Nouns, Auditory	.548	.464	.842			
5 Proficiency Test: Listening	.211	.202	.091	.001		
6 Proficiency Test: Reading	.283	.202	-.013	.024	.559	
7 Final Grade, Language	.160	.133	.166	.138	.294	.099
No Preference Group						
1 Persian Vocab., Visual						
2 Persian Vocab., Auditory	.739					
3 Paired Nouns Visual	.395	.455				
4 Paired Nouns Auditory	.547	.408	.780			
5 Proficiency Test: Listening	.176	.208	.187	.221		
6 Proficiency Test: Reading	.096	.170	.141	.178	.633	
7 Final Grade, Language	.080	.136	.079	.085	.249	.238

TABLE 5 (Continued)

	1	2	3	4	5	6
Visual Group						
1 Persian Vocab., Visual						
2 Persian Vocab., Auditory	.802					
3 Paired Nouns, Visual	.412	.480				
4 Paired Nouns, Auditory	.447	.227	.721			
5 Proficiency Test: Listening	.479	.447	.281	.288		
6 Proficiency Test: Reading	.232	.330	.009	.026	.188	
7 Final Grade, Language	.090	.073	.145	-.008	.049	.019

Table 6: Multiple regression equations and beta weights for predicting final language grades, listening scores, and reading scores; by MEB group.

Group	Regression Equation	Beta Weight
Auditory	Final Grade = 1.5 (ME) + 78.9	.056
No Preference	Final Grade = -.78 (ME) + 87.2	-.057
Visual	Final Grade = .49 (ME) + 47.7	.260
Auditory	Listening Score = -.36 (ME) + 16.7	.037
No Preference	Listening Score = .06 (ME) + 17.5	.007
Visual	Listening Score = .77 (ME) + 8.6	.060
Auditory	Reading Score = -.26 (ME) + 10.8	-.032
No Preference	Reading Score = -.31 (ME) + 13.9	-.030
Visual	Reading Score = -1.10 (ME) + 18.5	-.149

TABLE 7

Student agreement with five pro-auditory statements on Student Questionnaire I, by MEB group.

MEB group	Agree	Undecided	Disagree
Visual (N=125)	70 (56%)	18 (14%)	37 (30%)
Auditory (N=125)	60 (48%)	17 (14%)	48 (38%)

TABLE 8

Student agreement with five pro-visual statements on Student Questionnaire I, by MEB group.

MEB group	Agree	Undecided	Disagree
Visual (N=125)	62 (50%)	17 (14%)	46 (34%)
Auditory (N=125)	55 (44%)	44 (22%)	48 (38%)

TABLE 9

Student self-identification as eye-minded, no preference, or ear-minded, by MEB group.

MEB group	eye	no preference	ear
Visual	14 (56%)	6 (24%)	5 (20%)
Auditory	10 (40%)	7 (28%)	8 (32%)

TABLE 10

Students continuing FL study after one year,

by MEB group.

MEB group	continuing	not continuing
Visual	18 (72%)	7 (28%)
Auditory	17 (68%)	8 (32%)

TABLE 11

Students rated as attentive, average, and inattentive

by their first-year FL teachers, by MEB group.

MEB group	attentive	average	inattentive
Visual	9 (36%)	9 (36%)	7 (28%)
Auditory	8 (32%)	10 (40%)	7 (28%)

TABLE 12

Student liking for FL Class among other subjects,

by MEB group.

MEB group	1st	2nd	3rd	4th
Visual	4 (16%)	8 (32%)	8 (32%)	5 (20%)
Auditory	4 (16%)	13 (52%)	3 (12%)	5 (20%)

TABLE 13

Student liking for various FL class activities, by MEB group.

	1st	2nd	3rd	4th
Listening to the teacher				
Visual	5 (20%)	10 (40%)	4 (16%)	6 (24%)
Auditory	9 (36%)	3 (12%)	8 (32%)	5 (20%)
Doing oral drills				
Visual	5 (20%)	7 (28%)	11 (44%)	2 (8%)
Auditory	4 (16%)	5 (20%)	8 (32%)	8 (32%)
Reading a story				
Visual	11 (44%)	6 (24%)	5 (20%)	3 (12%)
Auditory	7 (28%)	9 (36%)	4 (16%)	5 (20%)
Writing exercises				
Visual	4 (16%)	2 (8%)	5 (20%)	14 (56%)
Auditory	5 (20%)	8 (32%)	6 (24%)	6 (24%)

TABLE 14

Teacher ratings of student performance in visual FL skills, by MEB group.

MEB group	good	average	poor
Visual	8 (32%)	10 (40%)	7 (28%)
Auditory	11 (44%)	8 (32%)	6 (24%)

TABLE 15

Teacher ratings of student performance in auditory FL skills, by MEB group.

MEB group	good	average	poor
Visual	7 (28%)	10 (40%)	8 (32%)
Auditory	12 (48%)	7 (28%)	6 (24%)

TABLE 16

Teacher ratings of student performance in visual FL skills, by self-expressed preference.

Preference	Good	Average	Poor	
Eye-minded	11 (46%)	6 (25%)	7 (29%)	N=24
No preference	7 (54%)	3 (23%)	3 (23%)	N=13
Ear-minded	0 (0%)	9 (69%)	4 (31%)	N=13